WV TAP
WEST VIRGINIA TESTING ASSESSMENT PROJECT

The Crude MHCM Chemical Spill 10 Home Study: Resident Behaviors, Perceptions, and Residence Characteristics

Andrew J. Whelton[1], Jeffrey S. Rosen[2], Jennifer L. Clancy[2], Timothy P. Clancy[2], Ayhan Ergul[2]
1. University of South Alabama, 2. Corona Environmental Consulting, LLC

March 27, 2014

1.0 Introduction and Methods

As part of the West Virginia Testing Assessment Program (WV TAP) project Task 3, 10 households affected by the Crude MCHM chemical spilled were visited. The objective of Task 3 was to conduct a focused residential drinking water sampling field study to be used to support the design of a larger more comprehensive program for the nine counties affected. As part of this effort, households were visited in eight of the nine counties affected by the drinking water contamination incident from February 11, 2014 to February 18, 2014. They include: Boone, Cabell, Clay, Kanawha, Lincoln, Logan, Putnam, and Roane counties.

An affected home in Jackson County was not visited because several of the Jackson County residents contacted declined participation and had switched to private well water since the drinking water contamination incident occurred. Further investigation revealed Jackson County had the fewest number of West Virginia American Water (WVAW) customers of the nine counties affected. A second home in Putnam County near the Jackson County line was visited in response.

During each household visit, residents were interviewed by the WV TAP project team in addition to the team chemically analyzing tap water at kitchen and bathroom fixtures, and collecting water samples for additional commercial laboratory analysis. Results of the resident interviews are contained in this document. Another document will be released that describes tap water chemical and odor testing results.

Resident interviews were conducted using the questionnaire found in the Appendix. Project team members completed the questionnaire while speaking with the household representative. Not all residents responded to all questions. Results shown in this document explicitly describe how many households are represented for each question.

2.0 Interview Results

2.1 Demographics and Notification

The survey of the 10 homes revealed an average of 3.3 people (range from 2 to 7) in each house and the age range of the person responding to the survey was 23 to 65 years old. Children, people older than 70 years of age, or individuals who may be immunocompromised lived in two (2) of the 10 households. All of the households learned about the 'Do Not Use' Order on January 9, 2014, the date the order was issued.

Most of the household representatives first learned about the 'Do Not Use' Order through discussions with friends and family members (Table 1). The next most popular method was television broadcast. Radio, Facebook, and phone alerts were less frequently cited.

Table 1. Communication Method Households First Learned about the 'Do Not Use' Order

Mode of Communication	Number of Households Responding
Word of Mouth	4
TV	3
Radio	1
Facebook	1
Phone Alert	1
Word of Mouth	4

Representatives from all 10 households responded to this question.

2.2 Residential Property Service Line, Plumbing System, Water Treatment, and Storage Characteristics

Plumbing system components were inspected and results showed a wide range of materials installed in the 10 homes examined (Table 2). Several homes visited had undergone plumbing renovations between 1986 and 2013. Of the 10 homes visited, water service connections were reported to be copper pipe (5), plastic pipe (4) and a combination of plastic and copper pipe (1). None of the homes had water treatment systems after the tap water passed through the water meter (whole house filter systems). Inside the homes, approximately 60% contained a single type of water plumbing pipe such as copper or plastic, while 40% contained mixed material plumbing systems. Nine of 10 homes had electric hot water heaters and water heaters were typically nine (9) years old with an age range of 3 to 16 years. Two (2) homes had a refrigerator water filter installed. Residents of one (1) home stored tap water in a container in the refrigerator or on a shelf. Another household (1) used a point-of-use filter to treat their tap water before drinking.

Table 2. Type of Plumbing System Materials Installed in Each Home

Characteristic Identified	Number of Households Responding
Single type of plumbing pipe	6
Mixed plumbing pipe system	4
Contained some plastic pipe	8
Contained some copper pipe	6
Electric hot water heater	9
Gas hot water heater	1
Refrigerator water filter	2

Representatives from all 10 households responded to each question; plumbing systems that contained plastic pipe included cross-linked polyethylene (PEX), polybutylene (PB), and chlorinated polyvinylchloride (cPVC) pipe materials.

2.3 Tap Water Odor, Taste, and Color Reports

Resident behavior and perceptions were recorded by asking a series of before incident / after incident questions. A tap water odor was reported by residents in nine (9) of the 10 homes before, during, or following the January 9 "Do Not Use" Order (Table 3). Only three (3) persons reported an unusual tap water color in their homes (Table 4). One person tasted the contaminated tap water and said the water had a sweet taste. None of the other people in the homes drank the contaminated tap water once the "Do Not Use" Order was issued (Table 5).

Table 3. Date Households Detected the Odor in their Tap Water

Date	Number of Households Responding	Odor Level
Odor never detected	1	-
6-Jan	1	3
9-Jan ('Do Not Use' Order issued)	3	3,4,4
10-Jan	1	5
11-Jan	1	4
12-Jan	1	5
13-Jan	1	4
14-Jan	1	4

Representatives from all 10 households responded to this question; Odor ratings: 1 no odor, 2 slight, 3 moderate, 4 strong, 5 unbearable.

Table 4. Date Households Detected Unusual Color in their Tap Water

Date	Number of Households Responding	Color Rating	Comments
Color never detected	7	-	-
14-Jan	1	2	-
30-Jan	1	3	-
8-Feb	1	NR	Oily film on water in sink

Representatives from all 10 households responded to this question; Color ratings: 1 clear, 2 slight, 3 moderate, 4 dark, 5 very dark.

Table 5. Date Households Detected the Unusual Taste in their Tap Water

Date	Number of Households Responding	Taste Rating	Comments
Did not taste the water	9	-	-
Date not reported	1	Not reported	Sweet

Representatives from all 10 households responded to this question; Taste ratings: 1 no taste, 2 slight, 3 moderate, 4 strong, 5 unbearable.

2.4 Plumbing System Flushing and Reported Symptoms

On average, residents flushed their plumbing systems 14 days after the January 9 'Do Not Use' Order was issued following the guidance provided by West Virginia American Water (WVAW). Some residents flushed within 4 days of the incident while other residents waited 37 days. Most of the residents reported experiencing rashes or eye burning symptoms when they contacted the contaminated tap water while flushing (7 of 10, respondents, see Table 6). These symptoms were reported most frequently. Dizziness was the second most frequently reported symptom followed by nausea and headaches. As of the date of the survey, four (4) of the 10 persons had spoken with a doctor since the incident occurred about the medical implications of exposure. Of the 10 homes, outside individuals visited four of those homes during and following the incident, but none were exposed to tap water because those homes were restricting exposure to tap water because of the contamination incident.

Table 6. Symptoms Reported by Each Household Following Tap Water Exposure

Symptom	Number of Households Responding	Ratings
Rash	4	3,4,5,5
Dizziness	4	3,3,3,5
Burning	4	3,3,3,4
Nausea	3	2,3,3
Numbness	2	2,3
Memory loss	2	4,4
Vomiting	1	2
Other: Headache	3	No rating
Other: Flu-like symptoms	1	No rating
Other: Agitated	1	No rating
Other: Skin itch	1	No rating
Other: Eyes red	1	No rating

Representatives from all 10 households responded to each question; Ratings: 1 no effect; 2 slightly different, 3 moderately differently, 4 very different, 5 severely different.

2.5 Level of Tap Water Contact

Results demonstrated that residents had not resumed their pre-spill water use activities. While all persons used tap water for flushing toilets before and after the incident, one (1) person chose not to use tap water for laundry purposes. At the time of the survey, four (4) households were not using tap water for showering and nine (9) were not using it for brushing teeth; none were using it for drinking, cooking, or baby formula. One (1) household had resumed using hot tap water for mixing hog feed. Surveyed results demonstrate that residents have not resumed their pre-spill water use activities.

Table 7. Level of Contact with the Water before the Incident and as of the Survey Date

Tap Water Use	Total Responding	Number of Households Responding	
		Before	After
Drink	10	5	0
Shower	10	10	6
Laundry	10	10	9
Flush toilets	10	10	10
Brush teeth	9	8	1
Cook	7	7	0
Animals	6	3	1
Baby formula	1	1	0

Representatives from 1 to 10 households responded to each question.

2.6 Resident Attitudes Toward Organizations and Comments

To ascertain resident opinions about the incident and organizations involved, a series of questions were asked regarding what organization they felt was the most responsible for causing the incident and their attitudes towards various agencies. Half of the persons surveyed felt that a West Virginia State Government Agency was most responsible, while some named Freedom Industries and WVAW (Table 8). Some respondents felt two organizations were equally responsible but were asked to select one. In the five (5) instances when two agencies were named, four (4) of five (5) named WVAW as bearing some responsibility.

Table 8. Organization Most Responsible for the Problems of the Incident

Organization	Number of Households Responding
West Virginia Government Agency	5
Freedom Industries	4
West Virginia American Water	1

Representatives from all 10 households responded to each question.

Discussions with homeowners generally revealed residents had reduced confidence in the US Centers for Disease Control and Prevention (CDC), US Environmental Protection Agency (EPA), and State Agencies. Confidence in WVAW was eroded as well. Interestingly, residents attributed more confidence to outside consultants than any other organization.

Table 9. Level of Confidence in Organizations before the Incident and as of the Survey Date

Organization Type	Name	Confidence Rating	
		Before	After
Federal Government	CDC	4.2 ± 1.5 (7)	2.3 ± 1.2 (9)
	EPA	3.5 ± 1.8 (8)	2.1 ± 1.3 (10)
	White House	3.0 ± 1.7 (6)	2.8 ± 2.0 (6)
Water Utility	West Virginia American Water	4.0 ± 1.4 (8)	1.6 ± 1.3 (10)
State Government	State Health Department	3.6 ± 1.5 (7)	1.8 ± 1.0 (9)
	County Health Department	3.5 ± 1.9 (4)	3.1 ± 2.0 (7)
	Governor's Office	2.9 ± 1.4 (9)	1.7 ± 0.9 (9)
	West Virginia DEP	2.6 ± 1.9 (9)	1.7 ± 1.3 (10)
Nongovernmental	Outside Consultants	4.3 ± 1.6 (6)	4.7 ± 0.8 (7)

Representatives from 6 to 10 households responded to each question; Ratings represent 5 = High confidence and 1 = Low confidence; Mean and standard deviation values shown for (n) persons responding.

In addition to the posed survey questions, the interviewer captured comments made by the residents about the spill and its aftermath. These comments are presented verbatim in most instances and summarized in Table 10.

Table 10. Comments by Residents

Home	Resident Comments
1	County was not in first official notification; resident called WVAW and was told incorrectly they were not in the affected area. Had to call for bottled water, feels County was forgotten. No confidence in Bureau of Public Health. Did not have confidence in the County Health Department in the beginning as they relied on WVAW and others in saying the water was safe, but then changed position and made independent comments, gained respect. State should have been checking chemical tanks all along. Wrote to the White House, 60 Minutes, Rachel Maddow and local weatherman; no response initially from anyone but Maddow then gave some coverage. Government handled the situation horribly and relied too much on WVAW and they knew the water wasn't safe. Government screwed up and said water was safe so no FEMA emergency money is available. No confidence in Obama administration, not mentioned in State of the Union address. Feels like this is the 1800s or Third World. West Virginia has been ignored.
2	Baby boy 8 months old went to the emergency room for throat rash as he was very hoarse. Water was brown when flushed on Jan 30.
3	City did not use emergency alarm system; felt City should have done so as that is what it is for. Female resident got nosebleed walking to work along the Elk River on the morning of January 9. Residents are long-term users of ceramic filter for all water ingested. Did taste some water at a restaurant on January 9 around 4:30 pm before 'Do Not Use' Order and thought it tasted off so they did not drink it, thought the Coke lines and water lines were mixed in the drink machine. Felt

Home	Resident Comments
	disoriented and left town for the weekend after the event occurred and shut off the water to the house. The smell from the water still comes and goes when running taps. High regard for Kanawha County Health Department. Feels State is responsible for spill as it is their role to regulate industry and keep people safe.
4	Resident flushed the house on January 18. Smelled sweet odor 3 to 4 days before January 9; headaches during flushing. Washed berries in tap water prior to January 9 and felt sick after eating them. Favorable opinion of Kanawha County Health Department.
5	Opinion of Kanawha County Health Department improved as the event progressed.
6	Smelled sweet odor in water 3 weeks prior to January 9; was licorice odor, now is lighter and sweet. After showering skin felt soft and silky like lotion that was not completely washed off. WVAW should have alarm system to detect when river water is contaminated; strong smell at first flush of taps each day. “No one in politics is doing anything”.
7	Homeowner worked with MCHM in 1980's and remembers the smell in the water as that same smell. Odor began on the third day, was unbearable. Did not shower or wash clothes for first two weeks after spill as clothes smelled of licorice. "Politics rules everything", would have preferred to receive call directly, not hear from news reports. Favorable opinion of Kanawha County Health Department.
8	District water agency that supplies WVAW was excellent, provided lots of information. Resident said that water is not piped from WVAW but there is a tank that is filled periodically from a truck. Thought they were spared as it took five days before smell occurred in their water.
9	Use tub hot water tap to mix hog feed in the morning; still have odor in water on first flush.
10	Felt faint after showering after flushing, lungs felt tight, wife had chemical burns after shower. They are at end of the system and had no odor until January 13, thought they had avoided the contamination.

3.0 FINDINGS

Interviews with representatives of the 10 households affected by the tap water contamination incident revealed several key findings:

1. The majority of the residents learned about the ‘Do Not Use’ Order by word of mouth (4 of 10 homes) and television broadcasts (3 of 10 homes), followed by Facebook, radio, and phone alert. Residents across the WVAW service area that were interviewed heard about the ‘Do Not Use’ Order on January 9.
2. Homes had a variety of plumbing materials including copper and a variety of plastics; nine of 10 homes had electric hot water heaters.
3. None of the homes had whole house water filters, and only one (1) had a treatment system after the tap. Two (2) homes had refrigerator water filters.

4. Residents in one (1) of the 10 homes never detected any odor in the water. The other nine (9) homes reported moderate to unbearable odor at some point on or after January 9.
5. Three (3) of the 10 homes noted some color change in their water which may have been as a result of flushing the system.
6. Nine (9) of the 10 homes reported not tasting the water once the 'Do Not Use' Order was issued; in the home where one resident did drink the water he reported it as sweet tasting.
7. All residents flushed their plumbing, on average 14 days after the 'Do Not Use' Order was issued. One resident first flushed his system 37 days after the incident. Seven (7) of the 10 reported rashes or burning eyes associated with flushing.
8. All homes used water for toilet flushing before and throughout the event. Four (4) homes were not using water for showering and nine (9) were not using tap water for teeth brushing at the time of the survey. None were using tap water for drinking, cooking, or making baby formula; only one (1) home used tap water for watering farm animals.
9. Prior to the contamination event, half of the households did not use tap water for drinking. Two (2) of 10 did not use tap water for brushing teeth and three (3) of 10 did not use tap water for cooking.
10. Half of the respondents felt that a West Virginia Government Agency was responsible for the contamination event for lack of oversight of industry. When more than one responsible party was named, WVAW was named in four (4) instances.
11. Where households had an opinion of a particular agency prior to the spill, they generally reported a lack of confidence in that agency after the spill. Kanawha County Health Department was named specifically by half of the respondents as an agency in which they had confidence. Outside consultants were also identified as holding resident confidence.

APPENDIX

WV TAP
WEST VIRGINIA TESTING ASSESSMENT PROJECT

CONSENT FORM FOR PARTICIPATION IN WATER ANALYSIS

RELATED TO THE MCHM SPILL

Corona Environmental Consulting, LLC has been contracted by the State of West Virginia to undertake a study of homes in Charleston, WV to assess presence and levels of 4-Methylcyclohexanemethanol or MCHM that may be present in tap water in homes. This study includes sampling domestic water within the home and interviewing household members. Observation of obvious plumbing in the homes will be noted.

Corona scientists are working with Dr. Andrew Whelton from the U. of South Alabama who has been involved in the incident from the earliest stages. The goal of this sampling and testing is to determine if MCHM as well as other chemicals that may be present in the water and at what levels.

Corona Environmental has contracted with two independent certified drinking water laboratories to conduct these analyses. Corona Environmental will collect the samples and ship them to the contracted labs. Corona samplers will conduct a brief interview with homeowners and/or those living in the home to understand: the water usage pattern prior to the event, water quality changes if any noted by persons living in the homes, and a short survey on household plumbing. **Homeowner/resident names in this study will be kept confidential.** By signing this consent form the homeowner releases the State of West Virginia, the Contractor, and its agents from liability.

Address: _____ _____

Signature of homeowner: _____

Signature of interviewer: _____

WV TAP
WEST VIRGINIA TESTING ASSESSMENT PROJECT

West Virginia Drinking Water Survey Questionnaire

1. Name of person(s) interviewed:
2. Address:
3. Phone: email:
4. Number of people living in the household (ages, sex):

5. When did you find out about the drinking water being contaminated?

_____ _____

6. Where did you hear about the incident first?
   a. TV b. Newspaper c. Radio d. Word of mouth
   e. Other:_____
7. Do household members regularly drink tap water? If no, do residents drink bottled water or use home water treatment devices (describe)?

Aesthetic

8. When did you first notice the water odor and describe the types? Has the odor(s) changed?

_____ ____

   a. Rate the strength of the water odor from 1-5
   (1 no odor, 2 slight, 3 moderate, 4 strong, 5 unbearable)

DAY:_____ 1 2 3 4 5

DAY:_____ 1 2 3 4 5

DAY:_____ 1 2 3 4 5

DAY:_____ 1 2 3 4 5

9. Did you notice any coloration in your water? Has the color changed?

_____ _____

   Rate the intensity of the color from 1-5 (1 clear, 2 slight, 3 moderate, 4 dark, 5 very dark)

DAY:_____ 1 2 3 4 5
DAY:_____ 1 2 3 4 5
DAY:_____ 1 2 3 4 5
DAY:_____ 1 2 3 4 5

If you noticed any changes in taste, when did first occur? Has the taste changed?

_____ _____

Rate the strength of the taste from 1-5 (1 no taste, 2 slight, 3 moderate, 4 strong, 5 unbearable)

DAY:_____ 1 2 3 4 5
DAY:_____ 1 2 3 4 5
DAY:_____ 1 2 3 4 5
DAY:_____ 1 2 3 4 5

10. Do you have any children, people older than70 years of age, or individuals who may be immunocompromised in the household:_____

11. Describe your level of contact with the water before the incident? After the incident?
    a. Drinking: _____
    b. Showering/bathing: _____
    c. Washing clothes: _____
    d. Brushing teeth: _____
    e. Cooking: _____
    f. Watering animals: _____
    g. Making baby formula: _____
    h. Flushing toilets:_____

12. Have you felt differently after contacting the water?_____Yes/No_____
    (1 No affect; 2 slightly different, 3 moderately differently; 4 very different, 5 severely different)
    i. Nausea: 1 2 3 4 5
    j. Vomiting: 1 2 3 4 5
    k. Diarrhea: 1 2 3 4 5
    l. Dizziness: 1 2 3 4 5
    m. Rash: 1 2 3 4 5
    n. Numbness: 1 2 3 4 5
    o. Memory loss: 1 2 3 4 5
    p. Other: _____ 1 2 3 4 5

_____ _____
_____ _____

13. Number of people (sex, age) visiting the household during the event if known:
14. Length of visit(s) if known.
15. What did visitors experience, if anything from air or water exposure?
16. Who/what organization do you feel is most responsible for the problems this incident?
17. Have you talked with your/a medical doctor since the event occurred? Yes/No

Information on Premise Plumbing

18. What type of pipe is installed in your –DRINKING WATER– plumbing system?
    a. Copper
    b. PEX
    c. cPVC
    d. PVC
    e. Other:_____

19. When was your plumbing system installed or last renovated?
    _____ _____

20. Have you flushed out your entire house, if so when? Date/ Time_____

Observations of Interviewer

Entrance of piping/material from meter into the house:

Is water treated after it leaves the service meter?

Whole house filter: Pitcher filter:

Fridge filter: Stored in container in fridge or on shelf

Materials noted in premise plumbing by interviewer:

Hot water heater: Type (electric, gas) Operation (on demand, continuous, intermittent)

Piping material in and out of heater:

Age of heater (if known):

Kitchen faucet: Separate cold and hot or blended, aerator, treatment device (ask homeowner to remove)

Level of confidence in agency before and after incident: Rate 5 high -1 low
CDC
USEPA
STATE DEP
STATE HEALTH DEPT
COUNTY HEALTH DEPT
WV AW
GOVERNOR'S OFFICE
WHITE HOUSE
OUTSIDE CONSULTANTS